The location of nuclear facilities is an important matter for the state health department. At present few state health agencies are organized, staffed, and equipped to exert complete control over radiation hazards. This paper presents a view of what is necessary for this goal.

STATE RESPONSIBILITIES IN THE SITING OF NUCLEAR FACILITIES

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THE building and operation of a nuclear facility may affect the environment in a number of ways. Such changes, directly or indirectly, may affect the health of the people living and working in the area. The general health of the people in the state is the most basic responsibility of a state department of health; hence environmental changes brought about by any nuclear facility are part of this responsibility.

On the other hand, the Atomic Energy Commission reviews nuclear reactor design and sites, and licenses reactors. This is done on the basis of radiological health considerations. Thus the question of pre-emption, or federal versus states' rights, is raised. This legal matter will not be discussed here but near the end of the discussion some general comments will be made.

Deferring, then, any legal problems, let us consider some of the environmental changes which may be caused by a nuclear facility and which are the responsibility of the state government. The action required by the state government will be illustrated by using New Jersey as the example. Although the names and details will vary from state to state, in general the same type of operation will be required in most states.

The facility may be a nuclear reactor, a reactor fuel manufacturing or reprocessing plant, a manufacturer of radiopharmaceuticals or of radiochemicals, or other facilities that use radioactive materials in large quantities. The environmental effects are going to differ markedly between such facilities. We will consider the more common ones, and we will start with those which do not involve radioactivity.

Environmental Effects Not Involving Radioactivity

Riparian Rights

A major nuclear facility such as a power reactor will probably require a large amount of water each day for cooling purposes and hence will need to be located on a body of water. If this is a tidal body of water, the right to locate on and use this water is involved. The right to have access to this water must be obtained from the attorney general. Dredging will require a permit from the Bureau of Navigation located in the Department of Conservation and Economic Development. Diversion of the water will require a permit from the Division of Water Policy and Supply of the same department.

Water Rights

If the nuclear facility will require fresh water for its operation, then permission to obtain the water from wells

or streams must usually be obtained. Such fresh water could be in addition to the cooling water mentioned above. Permission to obtain it is generally required and must be obtained from the Division of Water Policy and Supply located in the Department of Conservation and Economic Development.

Pollution Considerations in the Use of Fresh or Saline Water

The use of fresh or saline surface water in a fashion which will return all or part of the water to the source will also require approval and a permit to locate on the body of water because of possible pollution of the water that is returned. The required approval will be from the Stream Pollution Control Program in the Department of Health.

Increase in Water Temperature

The cooling water used in power reactors is discharged back to its source at an appreciably elevated temperature. If the discharge is to a stream, to the bay of a lake, or to the bay of an ocean, then consideration must be given to what changes this rise in temperature will produce. Both plant and animal life may be affected. For example, if the water is used for commercial or recreational fishing, it may be found that the fish population will be reduced, or even eliminated, largely by the reduction in the dissolved oxygen in the water. If the water serves as the basis of a general recreational area, then its desirability for this use may be nullified not only by the loss of fishing but by the production of obnoxious odors. Hence the economic benefits that will come from the power reactor must be weighed against the possible losses, both economic and recreational, that may result from its location in such a region. Such an evaluation is the joint responsibility of the Division of Water Policy and Supply of the Department of Conservation and Economic Development, and the Stream Pollution Control Program and of the Potable Water Supply Program, both of the Department of Health.

Effect on Underground Water

If the cooling water mentioned in the discussion of riparian rights, above, requires the digging of canals from the source of the water to the facility, then the probable effect of these canals on the underground water supply must be evaluated. If the canals are dug inland to any appreciable depth and not provided with a watertight lining, it is probable that continuous drainage into the canals will occur from the aquifer used by shallow wells. This water supply may thus be depleted for some area around the facility.

If the cooling water which will flow through the canals is salt water, then under some circumstances the reverse effect, namely saline intrusion, may occur. In this case the salt water may flow *into* the underground water table and render it unfit for drinking water.

The responsibility for evaluating these effects on the water supply of the area will lie with the Division of Water Policy and Supply of the Department of Conservation and Economic Development.

The five environmental effects just mentioned involve no considerations of radioactivity. They have, however, all involved water. No nonradioactive effects involving the air have been mentioned because pollution of the air by effluents is usually negligible; in fact one of the major advantages of nuclear over conventional power plants is the virtual elimination of nonradioactive air pollution.

Factors Involving Radioactivity

Environmental factors that involve radioactivity follow.

Radioactivity in Water from a Facility

The water that comes from a nuclear facility, whether it is waste water or

cooling water, will usually contain some radioactivity.

Radioactivity in the *waste water* can be controlled.

If the half lives are short, holdup or storage tanks can be used to reduce the activity to any desired level. If the activities are long-lived and their concentrations are above the maximum permissible concentration values for the mixture, treatment facilities can be built to remove most of the radioactive materials from the water. These materials can then be disposed of by a commercial waste disposal service as radioactive solids.

Radioactivity in the *cooling water* from a nuclear facility cannot usually be removed because of the large volume of water involved. In a reactor with a direct cooling cycle, the radioactivity in the cooling water is induced in the condenser by neutron reactions on impurities in the cooling water. The radioactivity concentrations will usually be well below the maximum permissible concentrations for the mixture. If so, the only concern will be possible reconcentration of one or more of the radionuclides by plant and animal life.

Such reconcentration will occur from both waste and cooling waters. For example, in a bay or lake, or downstream in the case of a river, fish or shellfish may have high radioactivity concentrations. An estimate must be made of these concentrations and then a decision reached as to whether they will be dangerous to individuals who eat a reasonable amount of the fish or shellfish.

The evaluation of the necessary treatment or effects of radioactivity in waste or cooling water is the responsibility of the Radiological Health Program in the Department of Health. If the environmental sampling of water, or animal life in it, is desired when the nuclear facility is operating, then a specific sampling program should be worked out and agreed to by the applicant as a condition of approval by the Radiological Health Program.

Radioactivity in Air from a Facility

The air released from a nuclear facility will almost always contain radioactivity. The amount of radioactive materials released per year will vary greatly with the kind of facility. Even with power reactors, the amount will vary radically with the type of reactor and its size. A typical range will extend from millicuries to thousands of curies per year.

As to removal, in some cases it is feasible and desirable to remove radioactive particulates by filters, and radioactive gases by some type of chemical treatment. In many cases, however, neither of these procedures is feasible because of the volume of air being released per day. If this is the situation and the radioactivity concentrations are above the maximum permissible concentrations for the mixture, then the air must be released from a stack and advantage taken of the average dilution that occurs between release and the reaching of ground level. The estimation of the maximum yearly average concentrations at ground level is an involved problem. First, fairly extensive meteorological data must be obtained for the location. This must include such things as hourly wind velocity and direction, temperature, frequency and duration of temperature inversions, and so on, and these data should be available for a period of several years. Then theoretical equations, such as those of Sutton, are used to obtain the maximum yearly average concentration at ground level.

It sometimes happens that calculations such as those just described lead to the determination that the limiting condition for a person living near the periphery of a nuclear facility is not the average concentration of radioactiv-

ity in the air at ground level, but rather the *external* gamma radiation received by him from the radioactive plume overhead, i.e., the radioactivity in the air *above* him, rather than the radioactivity in the air which he breathes.

Regardless of which is the limiting condition, the height of the necessary stack is determined by such calculations. Unless the terrain is very uniform, it is most important to have meteorological data taken at the site.

The applicant should work out an environmental sampling program, including the specification of what meteorological data are to be taken before operation, how the calculations are to be made from the data, and what environmental sampling program is proposed after operation. It is the responsibility of the Radiological Health Program in the Department of Health to carefully check this proposed program and, if necessary, modify it to make it acceptable. This program, as modified, must then be agreed to by the applicant as a condition of approval by the Radiological Health Program.

Problem from State Viewpoint

The discussion turns now from considerations limited to the environmental or health aspects of nuclear facilities to consideration of the total problem from the viewpoint of the state. A company or organization proposes to build a major nuclear facility in the state. What procedure should a state follow in evaluating the proposed facility and in granting authorization to proceed? This problem deserves considerable effort and attention because probably no state has as yet satisfactorily solved it.

States have been handling the building of major industrial plants for many years. Why, then, do we have a new problem when a state has to consider the building of a nuclear facility? One fundamental difference is of course the release of radioactivity to the environment as well as the possible exposure of the workers in the facility to radioactivity or to radiation. The other part of the problem is that some nuclear facilities, particularly reactors, are getting larger and larger and their environmental effects are becoming more and more significant. In this second part of the problem, reactors are no different from many major nonnuclear facilities. It is simply that as industrial installations have gradually grown larger and, in some cases, have produced major environmental effects, state governments have not sufficiently adjusted their organization to cope with the new problems. Most states still operate by small and essentially isolated bureaus or sections of the various departments, each considering the proposed industry only from its own limited domain of authority. There is generally no part of a state government that coordinates the activities of the many bureaus and sections of the different departments, that looks at a problem as a whole, and comes to an over-all judgment.

To emphasize this, consider the sections or parts of a state government that would currently be involved in the building of a new nuclear facility. The seven environmental considerations which have been mentioned involve seven different groups in four departments, namely, the Department of Health, the Department of Conservation and Economic Development, the Board of the Public Utility Commissioners, and the attorney general. Considering all of a state government, there are at least two more groups involved.

Approval of the plans for construction would be necessary from the standpoint of safety and the various building requirements of the state. This approval would be given by the Bureau of Engineering and Safety in the Department of Labor.

If the nuclear facility is a power reactor, approval must be obtained from the Board of Public Utility Commissioners. Such approval will be based on

the adequacy of the financial resources of the company to build the plant, and of the plant to safely, adequately, and properly supply the necessary electrical power. If the company must by the power of eminent domain acquire any land for the construction of the plant or other facilities, it can not exercise this power without the approval of the Board of Public Utility Commissioners.

We thus have a total of as many as eight groups located in five different departments involved in the approval of the building of a new nuclear facility and, in general, these groups will all act independently of one another. What may be needed is a modification of state government organization which will provide a mechanism for looking at the problem from the over-all point of view and which will coordinate these various groups.

Even if there were *no* unresolved legal problems, the individual states are currently in an extremely weak position in trying to control the construction of nuclear facilities because of this lack of central organization to coordinate and carefully evaluate applications. In contrast to this, the federal government is in a very strong and well organized position because of the centralization of control in essentially one body, namely, the Atomic Energy Commission.

Since the writer is not an authority on state government, it would be inappropriate for him to try to suggest the details of how a state government should be modified to correct the foregoing deficiency. But because at least five major departments or divisions are involved, it is suggested that the reorganization to provide for central coordination and control might come by an executive order of the governor or by a law passed by the legislature.

Near the beginning of this discussion, the problem of pre-emption was mentioned, or of state versus federal rights in the control of nuclear facilities and radiation exposure from by-product, source, and special nuclear materials. Many studies have been made of this problem. Briefly stated, there is no clear answer to many areas of the problem. In fact, in passing the 1959 Amendment to the Atomic Energy Act of 1954, Congress deleted a pre-emption statement (in Sec. 272(k)) which explicitly stated that the intent of the act was to remove the control of these radiation hazards from the states and give them to the Atomic Energy Commission. It was apparently felt that this might be unconstitutional because of the fundamental right of the states to control the health, safety, and welfare of their citizens.

It would seem that what Congress has done in the years since the end of the Second World War has been simply to do that which was obviously and practically necessary in the control of the new radiation hazards that had developed. The state governments did not have either the trained manpower or the facilities to control them. Control was obviously necessary—no one disputes that fact—and so Congress did the only practical thing possible and gave the control to the Atomic Energy Commission, even though there may have been some doubt about the legality of doing this.

Certainly until the last few years, no state government has been in a position to claim that it was organized, staffed, and equipped to exert complete control over all radiation hazards. And in view of the organizational deficiency discussed earlier, it would seem that perhaps no state is completely ready to do this today, although a number of states are now very close to being able to. But it is to be emphasized that it is a basic responsibility of state government to provide adequate staff and facilities for controlling *all* environmental radiation hazards. This includes nuclear reactor design and evaluation of proposed sites.

During the present transitional period

it is suggested that the Atomic Energy Commission take a more realistic view of the abilities of at least some of the states to control all radiation hazards. Also during this period the commission should recognize that control of nuclear power reactors involves many disciplines not concerned with radiological health and should modify its procedures to allow *cooperative* consideration of applications by both the commission and the state concerned. This would allow all of the problems involved to be considered and satisfactorily solved. Neither the Atomic Energy Commission nor any state wishes to go through the long-drawn-out struggle of a Supreme Court solution to the pre-emption question. Instead, then, let the commission and the states recognize each other's knowledge, abilities, and responsibilities. Hopefully, in time, the situation can be clarified without resort to the courts.

I wish to close by stating that the opinions expressed have been entirely those of the author. They do not necessarily reflect the views of any official of the state of New Jersey.

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WHO Fellowships

The World Health Organization will make available to United States health workers in 1968 a limited number of short-term fellowships for "the improvement and expansion of health services" in the United States. Applicants must be engaged in full-time public health or educational work. United States employees are not eligible. The awards, limited to two- to four-month travel programs, will cover per diem and transportation costs. Employers will be expected to endorse applications and continue salaries for the period of the fellowship.

Further information from William S. Wilson, Public Health Service, Washington, D. C. 20201.